CLT in the U.S.

Manufacturing and Applications

Presented by:
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Course Description

Architects around the world are using mass timber construction systems to build taller wood buildings, incorporate the aesthetic of exposed wood, or increase the amount of prefabrication on their projects. Many use cross-laminated timber (CLT) panels and glue-laminated timber (glulam) beams as the building structure, often as a carbon-friendly alternative to conventional materials such as steel, masonry and concrete. In this presentation by DR Johnson, successful U.S. projects will be highlighted to demonstrate the variety of commercial and multi-family applications available for CLT under today's building codes. Topics will also include CLT manufacturing, benefits such as structural versatility, and potential future uses.

Learning Objectives

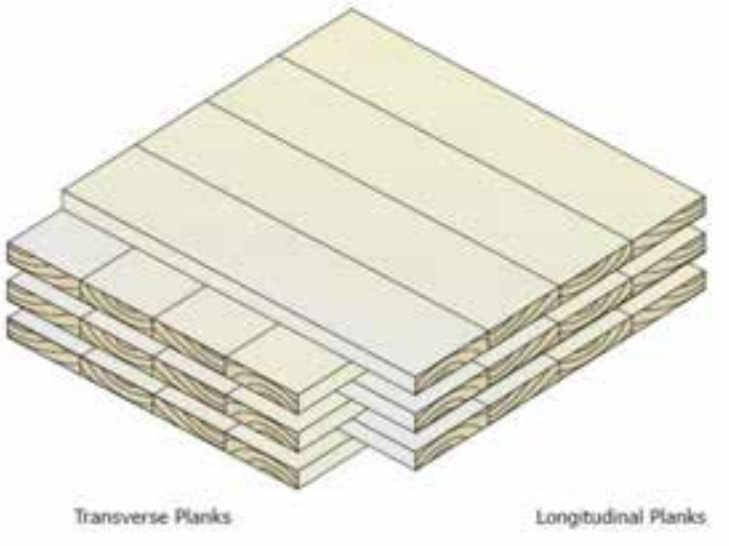
1. Identify CLT manufacturing processes and consider how CLT can be used successfully under current building codes and standards.

2. Discuss benefits of using CLT, including structural versatility, prefabrication, lighter carbon footprint, and reduced labor costs.

3. Review completed CLT projects that demonstrate a range of applications and system configurations.

4. Highlight possibilities for the expanded use and application of CLT in larger and taller buildings.

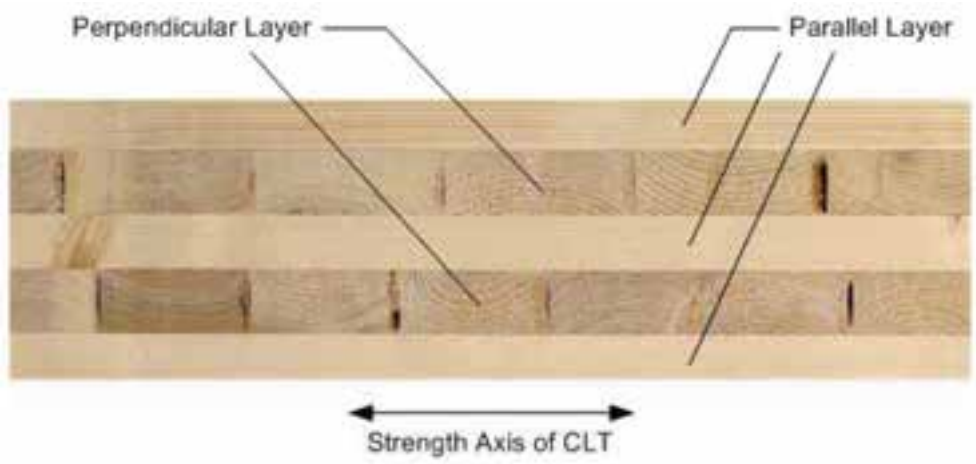
What is Cross Laminated Timber?



- Secondary Wood Product
- Several layers of lumber stacked crosswise
- Bonded together with structural adhesive
- Generally 3, 5, 7, or 9 layers thick

Ref: Fig 1, CLT Handbook: Cross Laminated Timber. FPInnovations (2013).

What is Cross Laminated Timber?



CLT Layup Examples

3-ply 3-layer

5-ply 5-layer

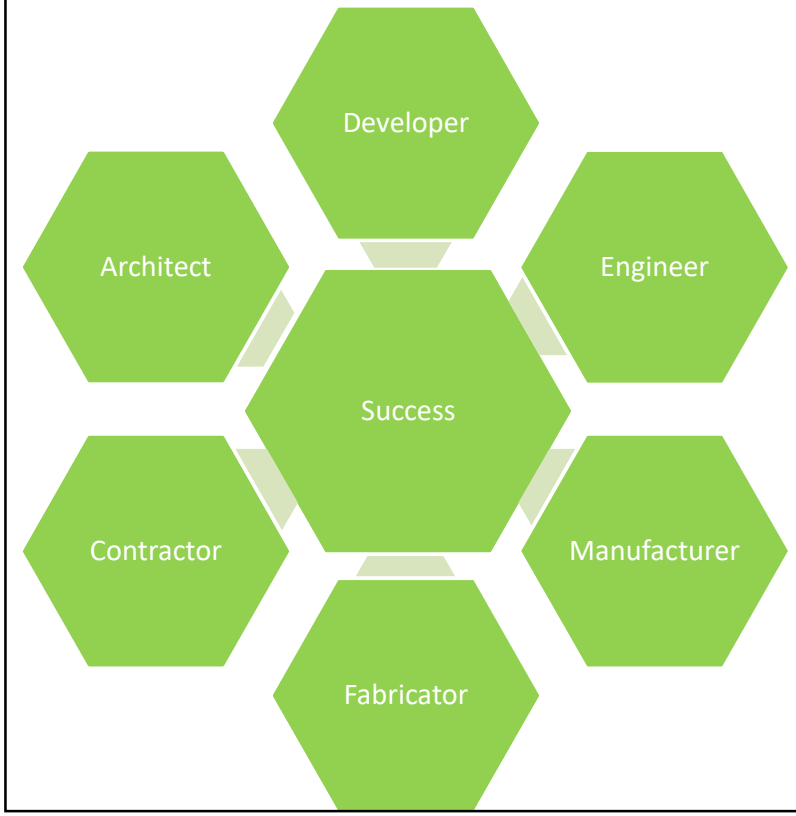
7-ply 7-layer

9-ply 9-layer


NATURE SUSTAINS
NATURE UNITES

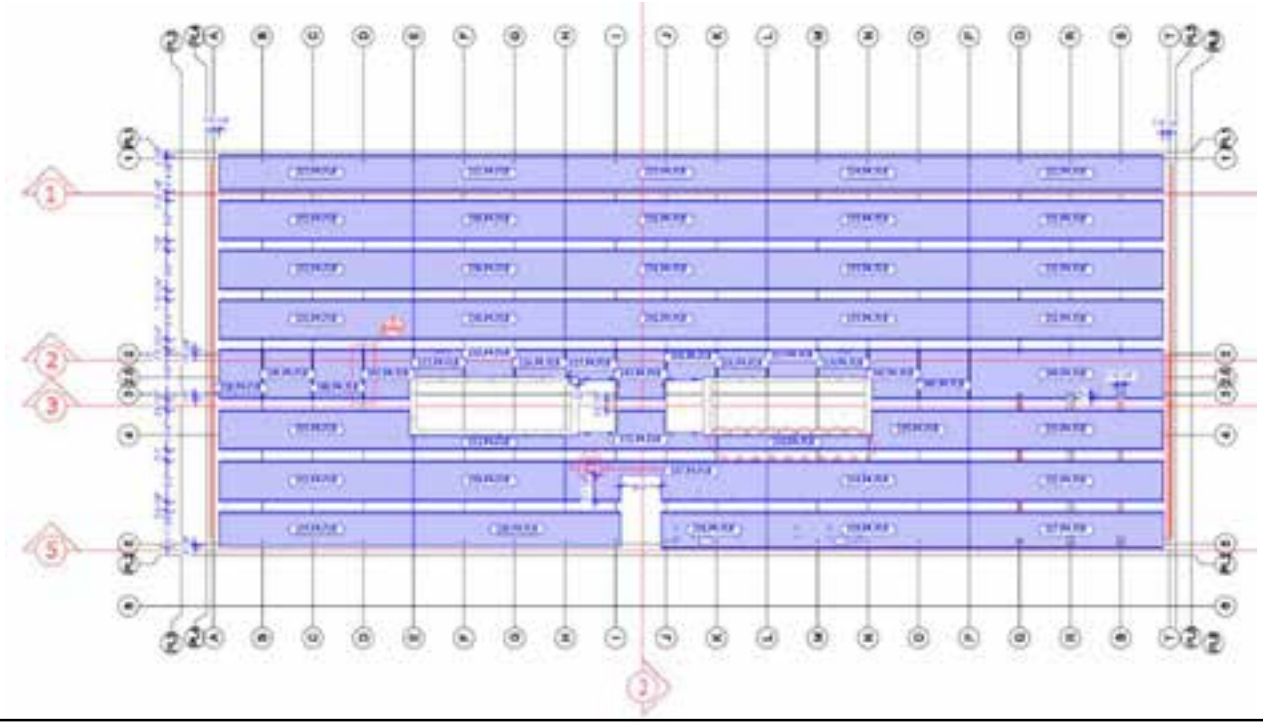
CLT - Manufacturing

Team Collaboration

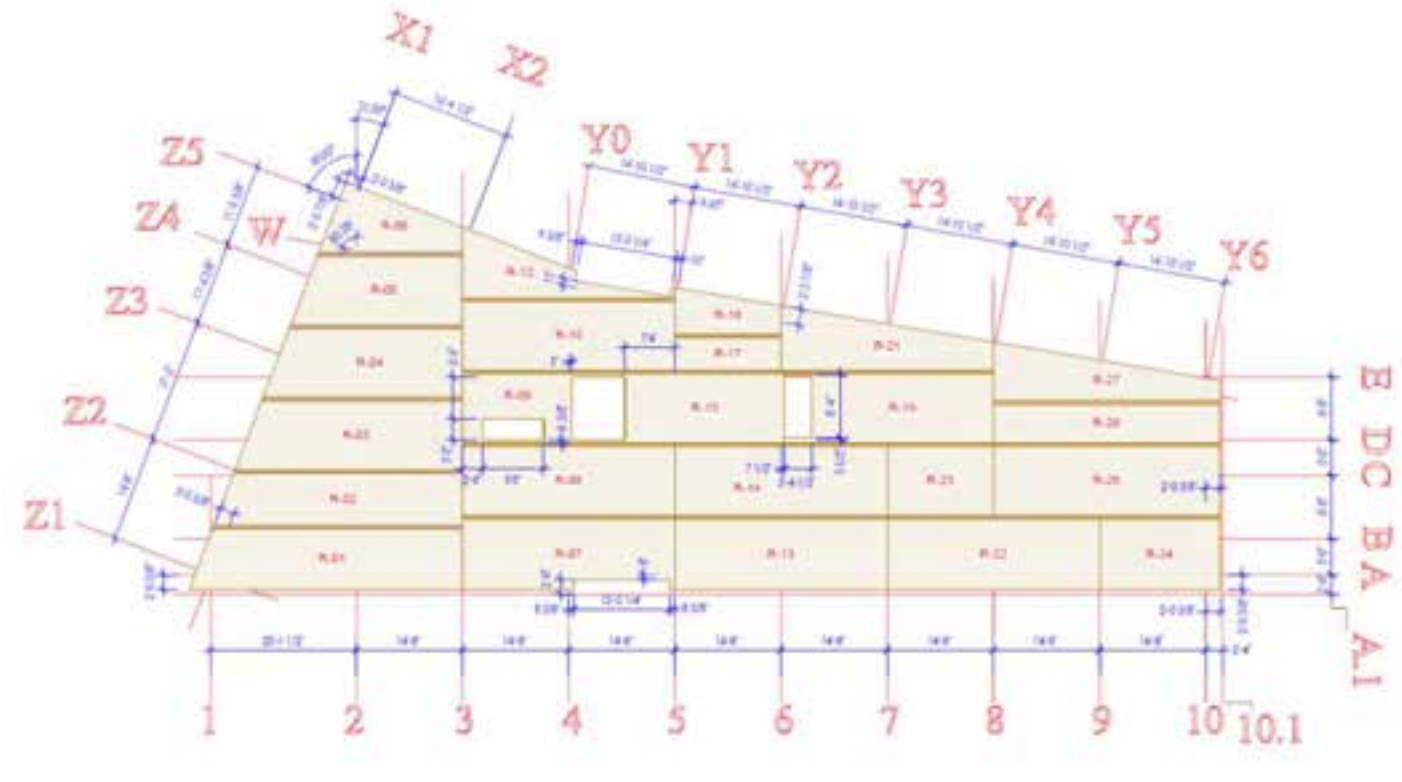


When to Start

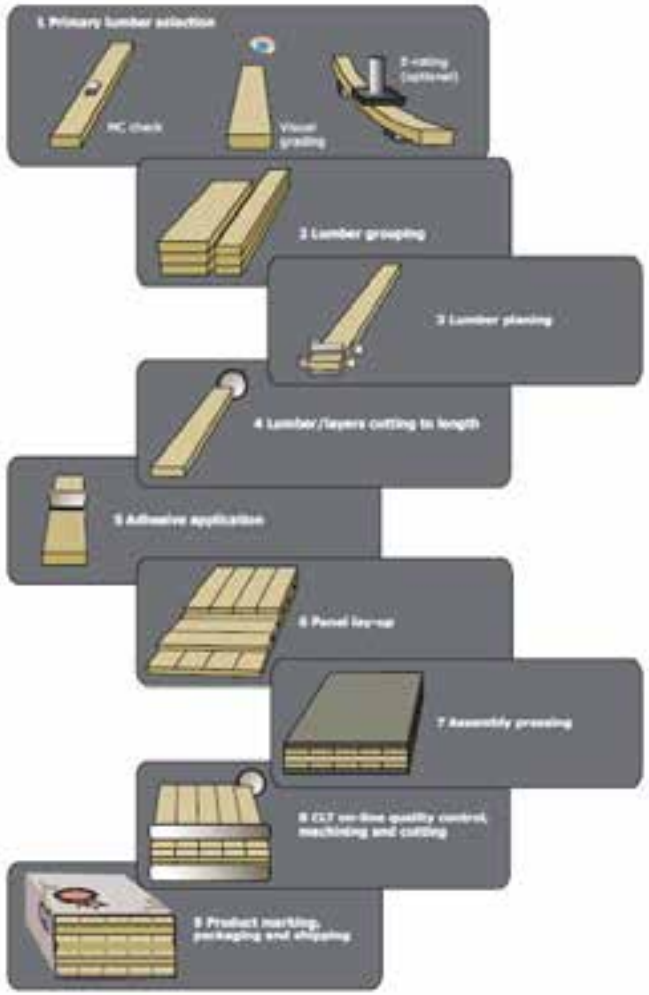
Preferably During Schematic Design



Not All Projects are Rectangular



CLT Manufacturing



Ref: Fig 2, CLT Handbook: Cross Laminated Timber. FPInnovations (2013).

CLT Product Standard

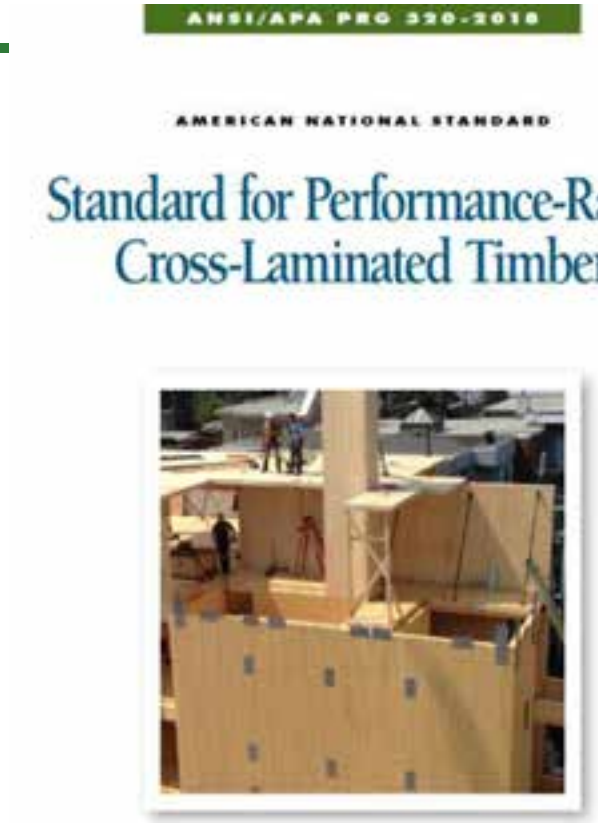
Consensus standard

Sets minimum performance requirements

Requires independent 3rd party inspection

Gives code officials assurance

Designers focus on design & innovation



ANSI/APA PRG 320 – Key Considerations

Dry-use

12% Moisture Content

Lamination thickness: 5/8” to 2”

Size Tolerances: Thickness = 1/16”, Width = 1/8”, Length = ¼”

Adhesives: sets fire performance criteria

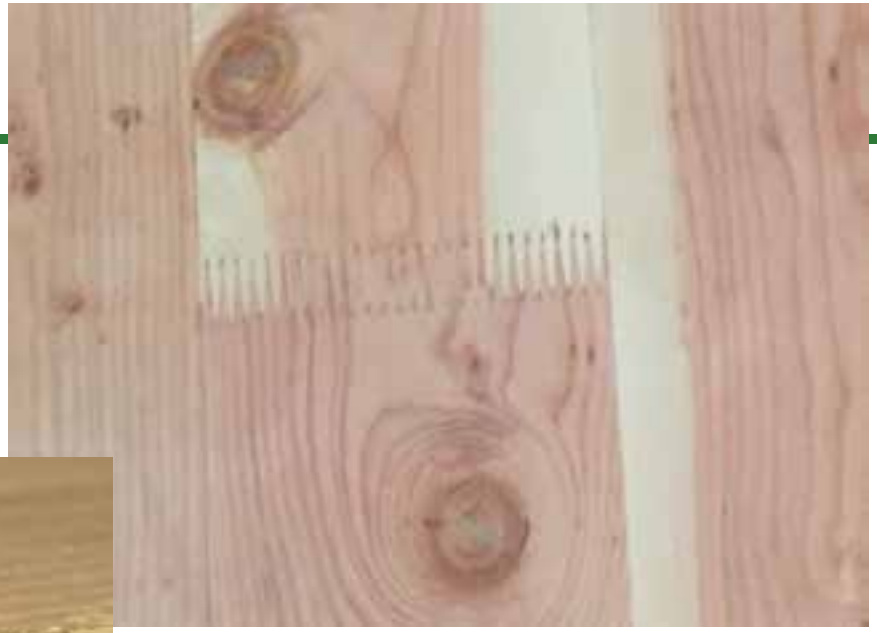
Standard grades of CLT

Species of Lumber Used

- Douglas fir-Larch
- Spruce-Pine-Fir
- Southern Yellow Pine
- Hem-Fir

End Joints

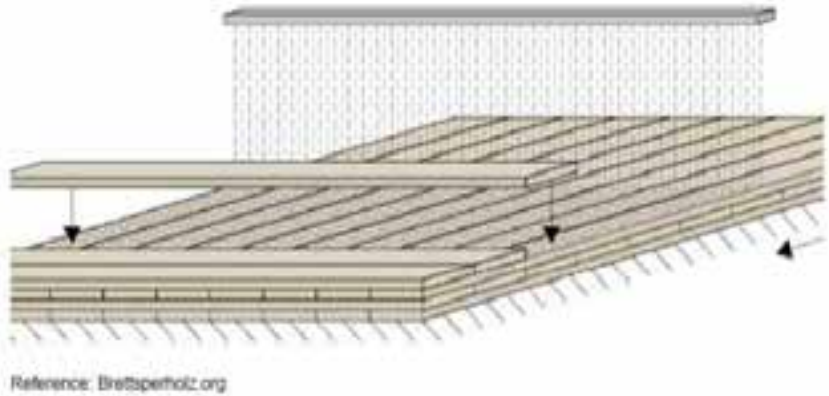
- Finger Joint
  - Horizontal
  - Vertical



Ref: https://www.nrcan.gc.ca/forests/industry/products-applications/15837

Face Joints

Application of adhesive to wide face of lumber



CLT Manufacturing

CLT Manufacturing

CLT Fabrication

CLT – Lifting Anchors

CLT – Just in Time Delivery


Photo By: Brad Nile – Andersen Construction

CLT in Building Codes – 2015 & 2018 IBC

CLT permitted in various Types of Construction

	Type I	Type II	Type III	Type IV	Type V
CLT Floors			✓	✓	✓
CLT Roofs	✓ (1-hr or less FRR)	✓ (1-hr or less FRR)	✓	✓	✓
CLT interior walls			✓	✓	✓
CLT exterior walls				✓	✓

2021 IBC – Proposed Changes

Modernizing Type IV Heavy Timber for Tall Wood Buildings

Type of Construction	Max Height	# Stories	Exposed Mass Timber	Primary Frame FRR	Floor FRR	Stair Tower	Concealed Spaces
IV-HT	85 ft	4-6	fully exposed	HT (2021)	HT	Mass Timber	Permitted (2021)
IV-C	85 ft	4-9	fully exposed	2 hr	2 hr	Mass Timber	Permitted
IV-B	180 ft	6-12	partially exposed	2 hr	2 hr	Mass Timber	Permitted
IV-A	270 ft	9-18	fully protected	3 hr	2 hr	Noncombustible	Permitted

Courtesy of: American Wood Council

CLT - Benefits

- Renewable Resource
- Alternative to Concrete/Steel
- Flexible Design
- Fast Installation
- Fire & Seismic Performance

Domestically Grown

- Support US Forest economy
- Revitalize rural communities

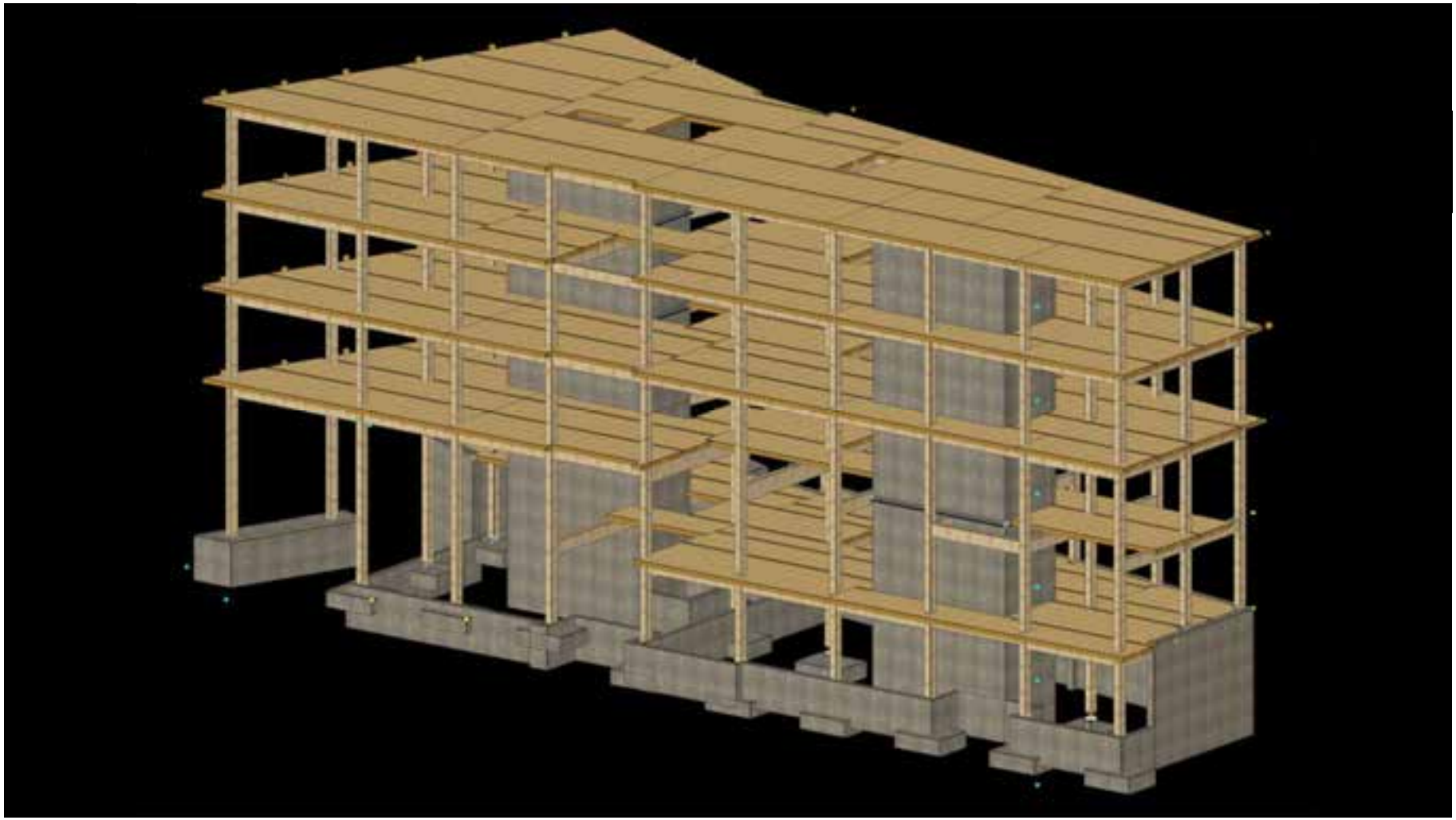
Sustainability

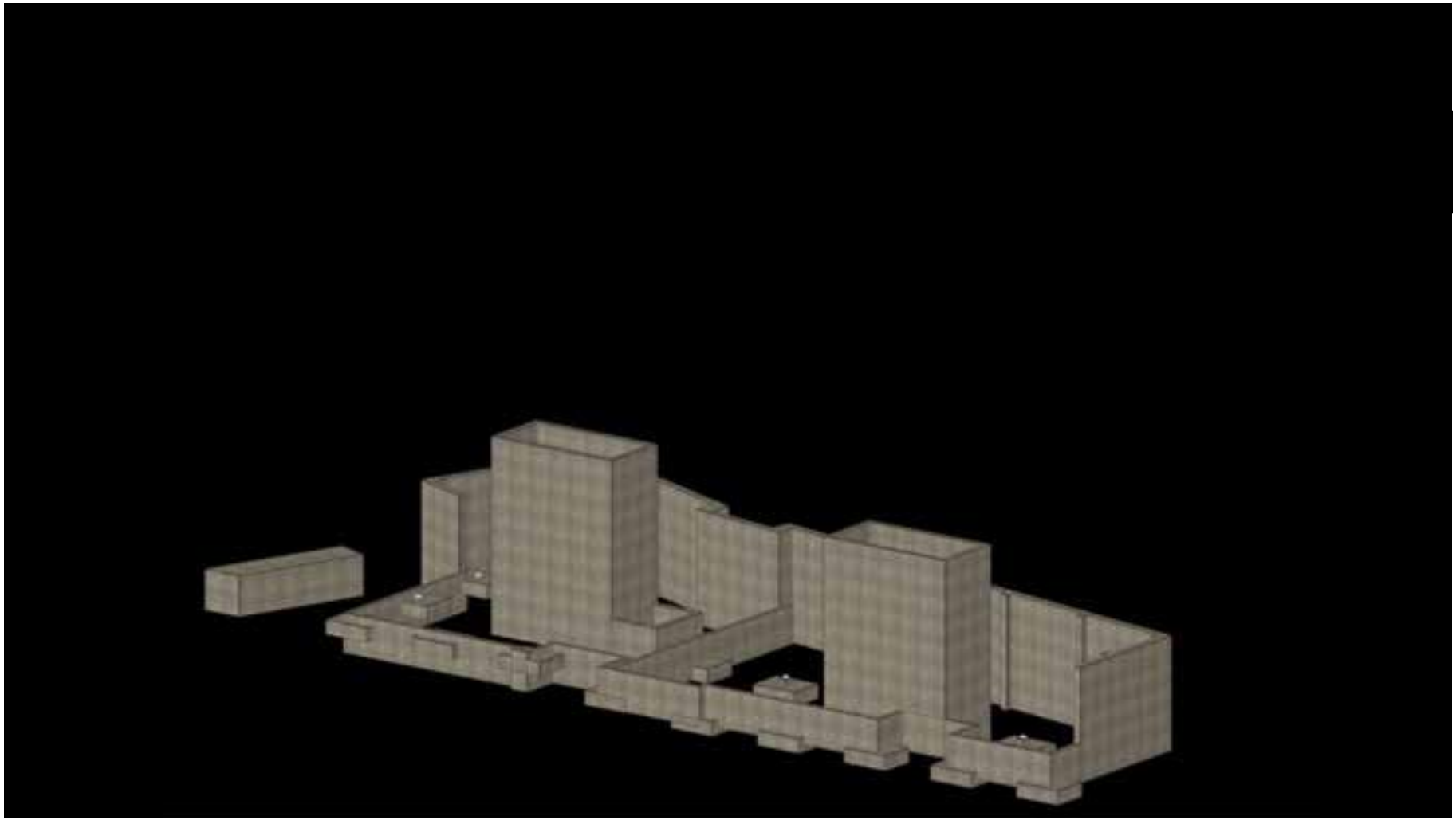
- Wood buildings store carbon (50% of dry wood weight is carbon)
- Wood buildings currently store 5.4 billion tons of carbon
- Lighter, higher precision, and faster construction time compared to concrete
- Sustainable forest management

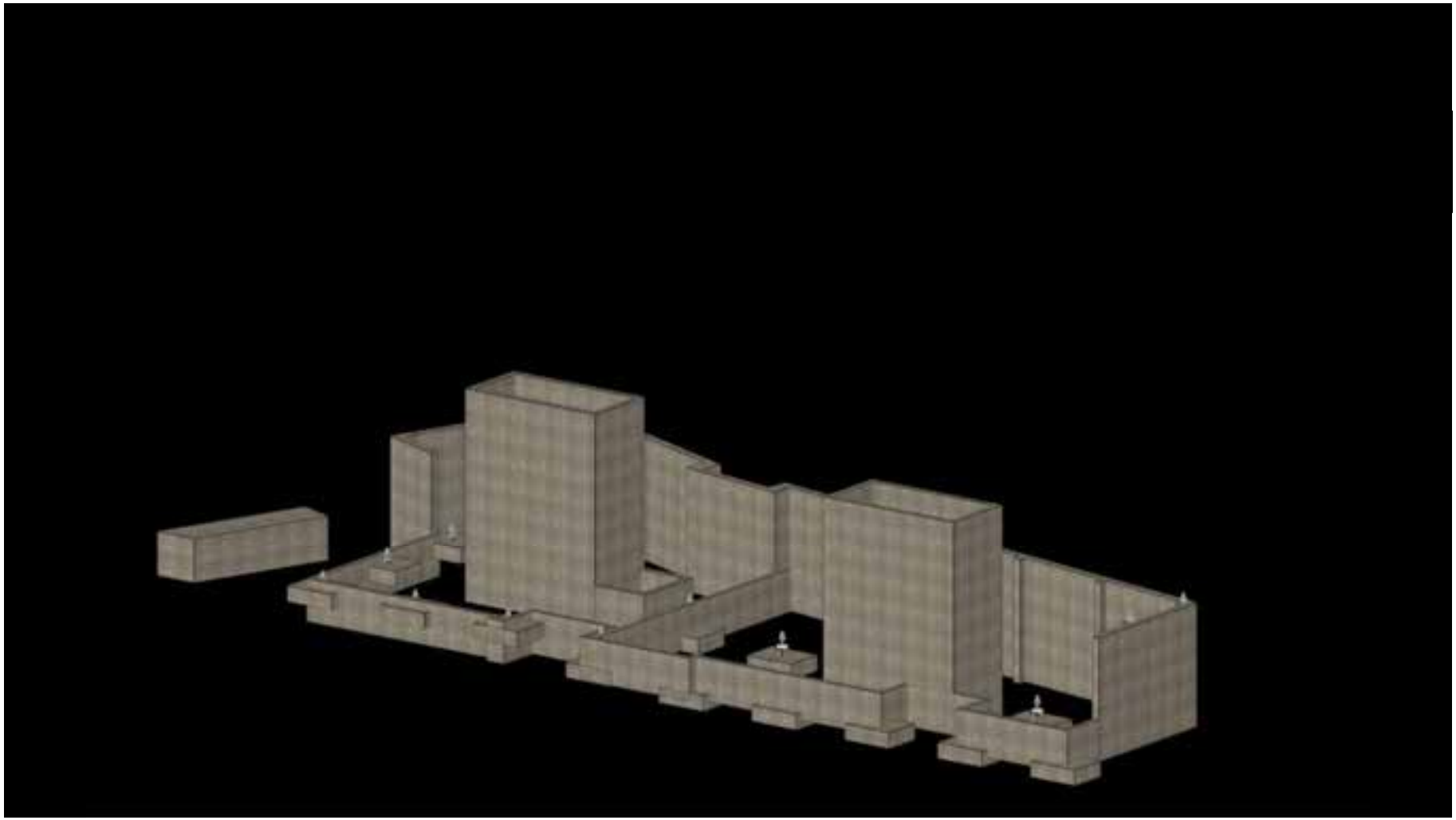
CLT Installation

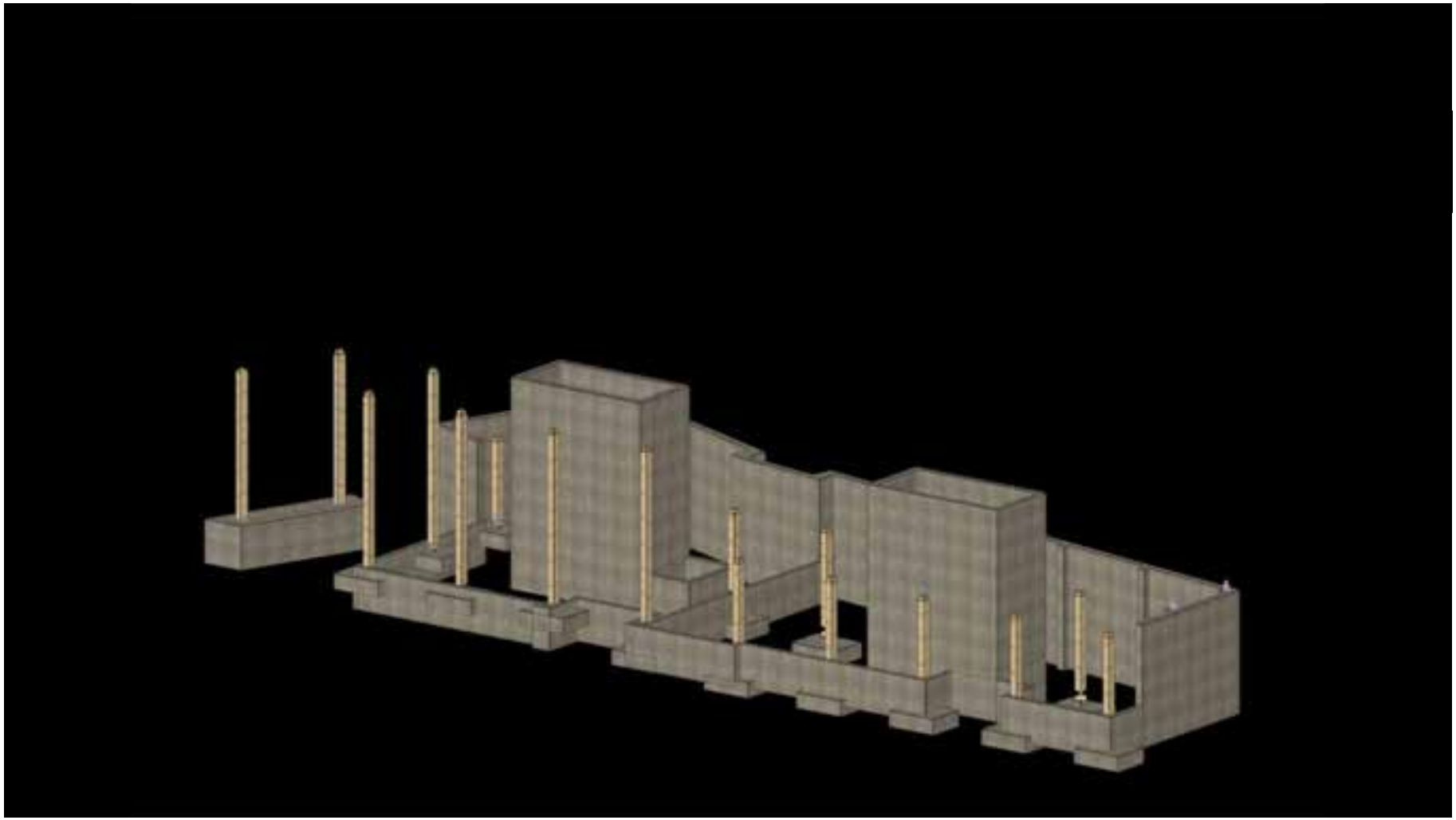
- Small Crews
- Rig, pick, set, secure

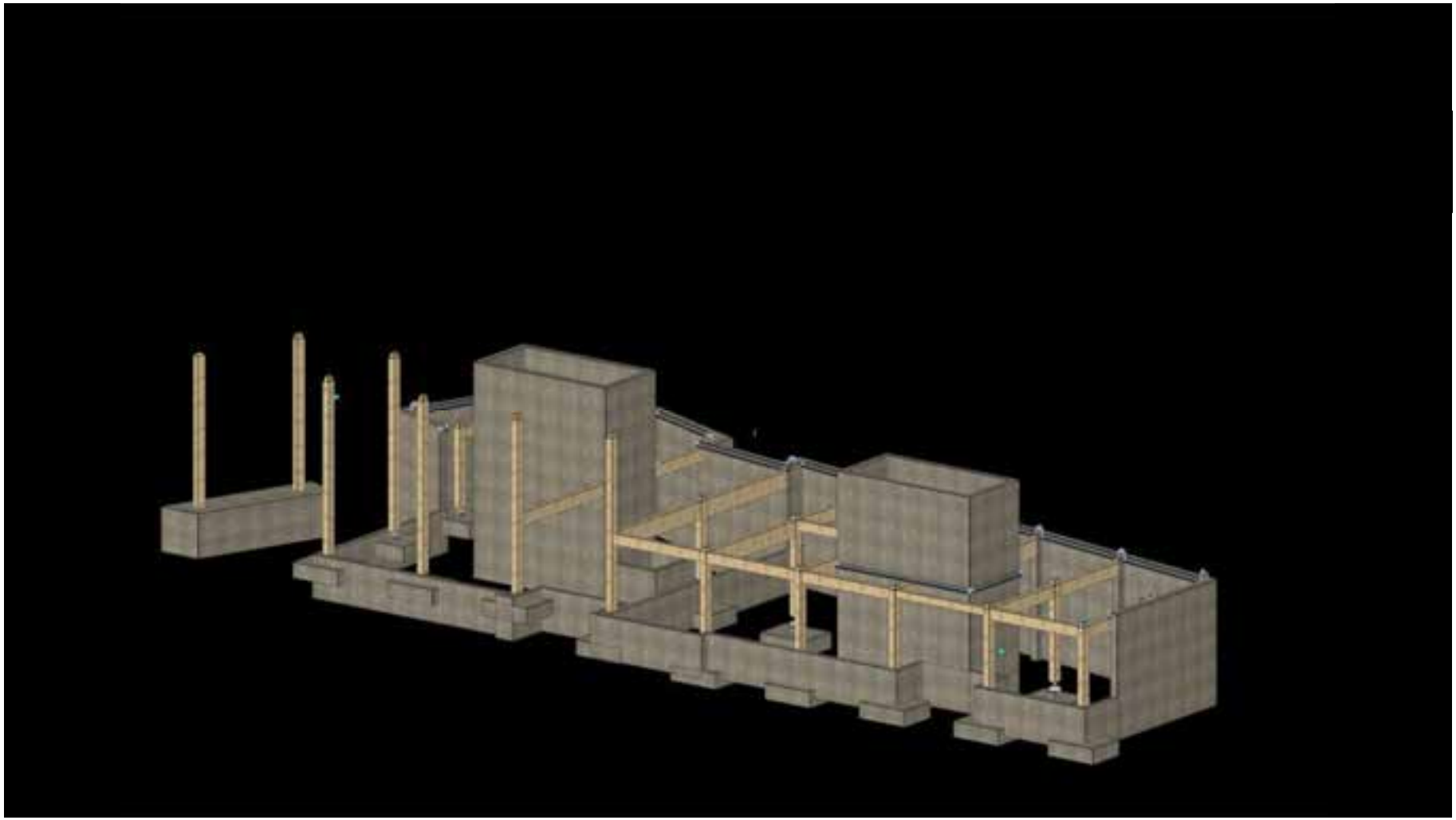
CLT Installation

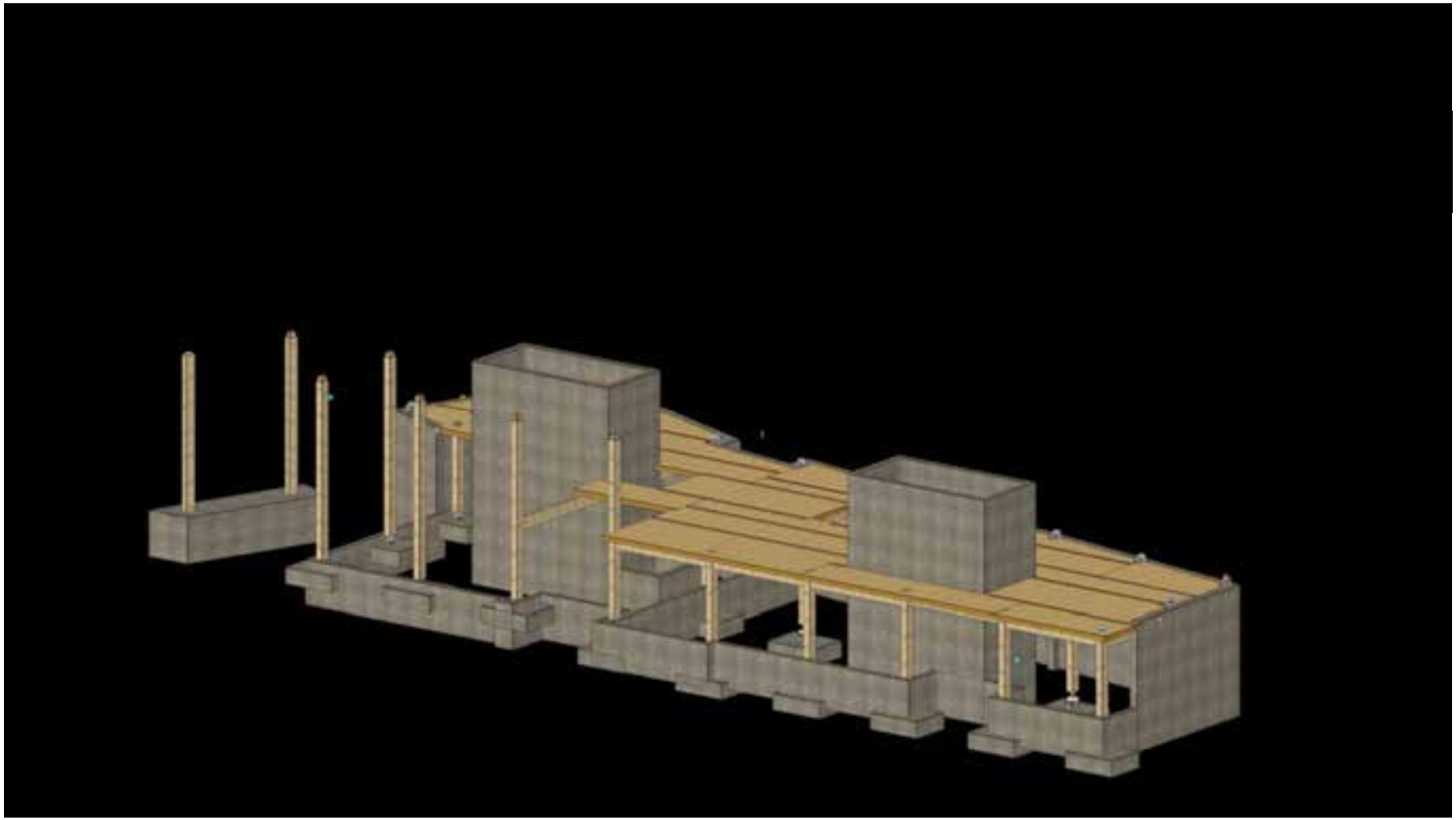


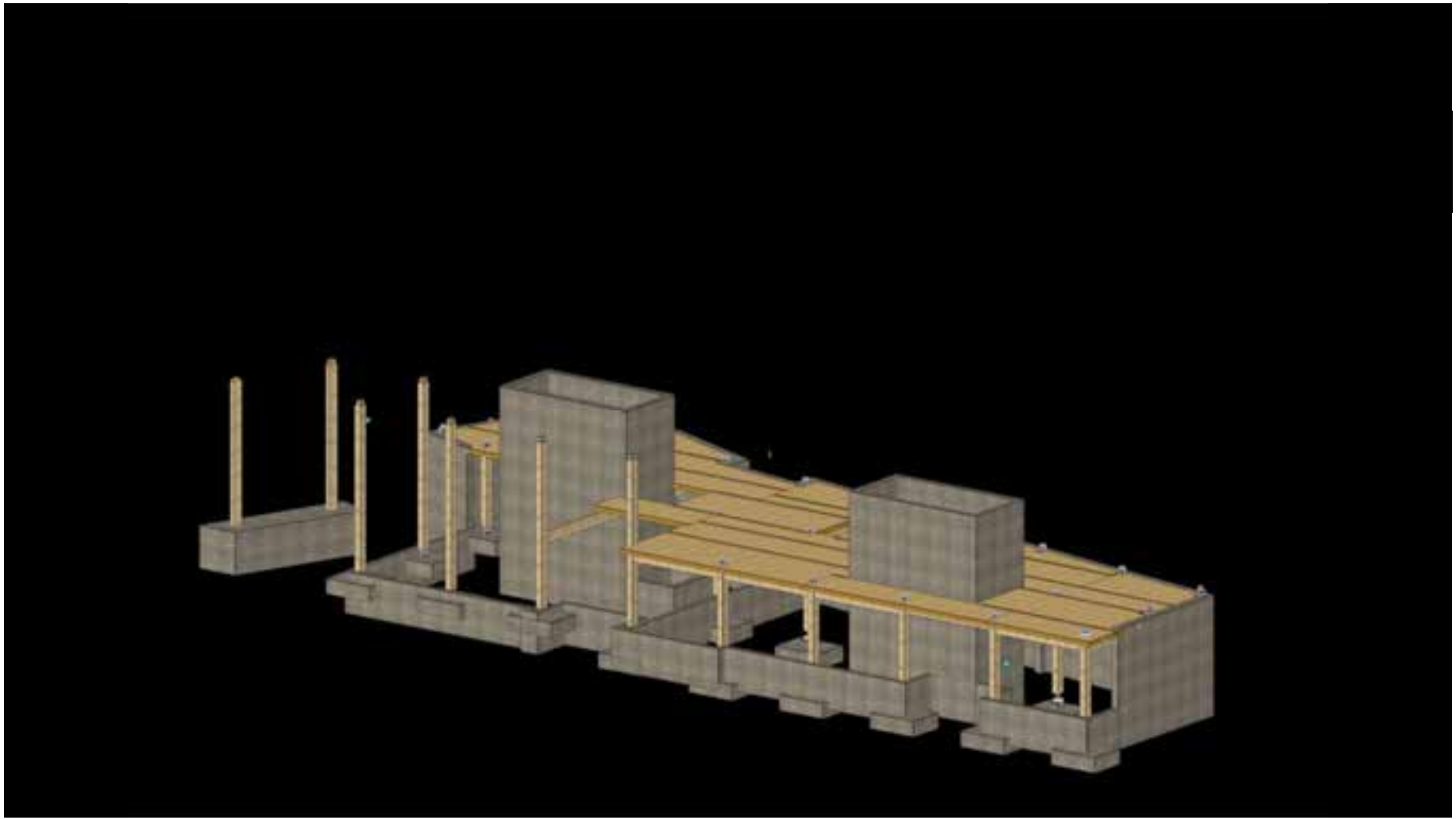


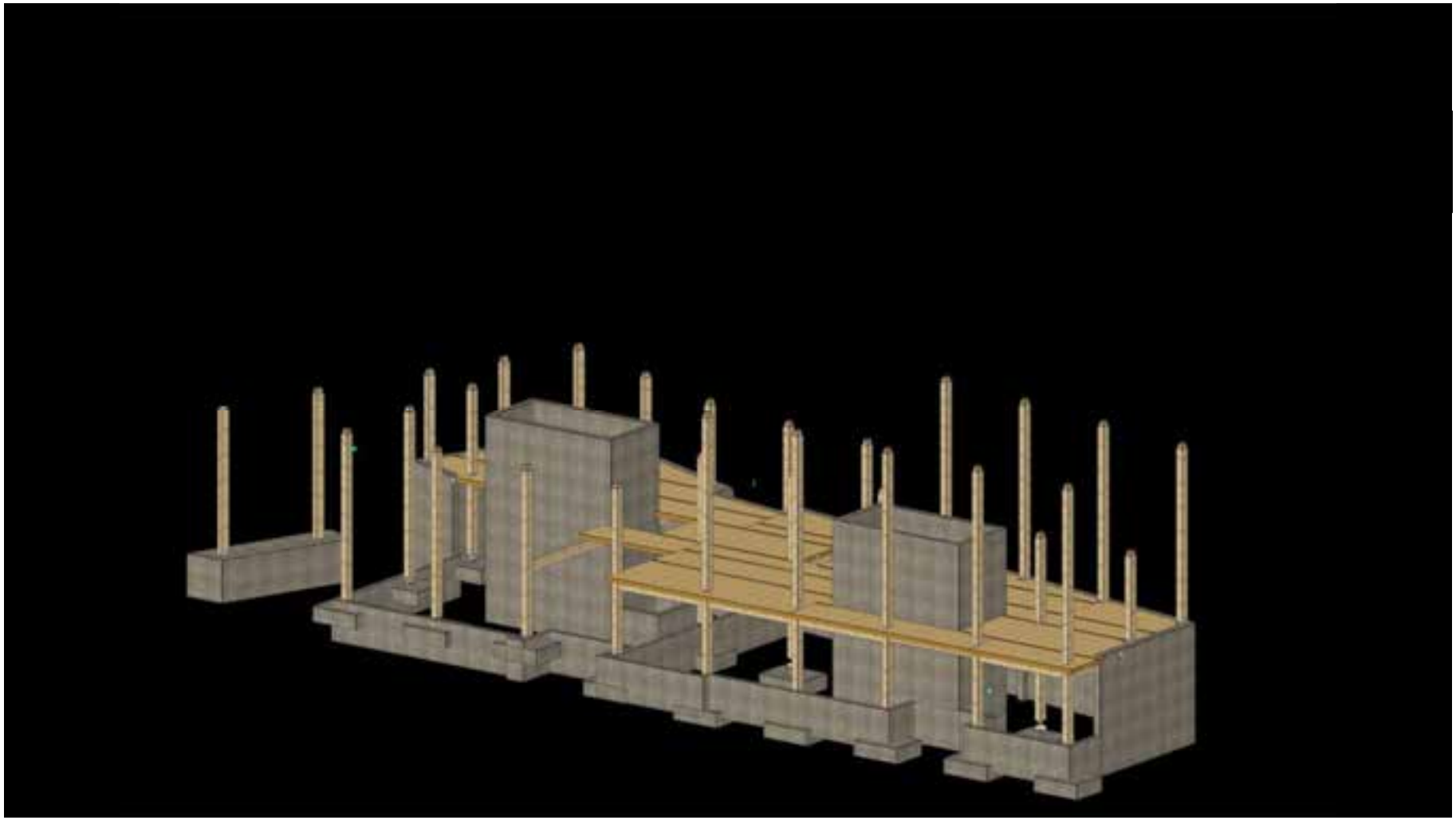


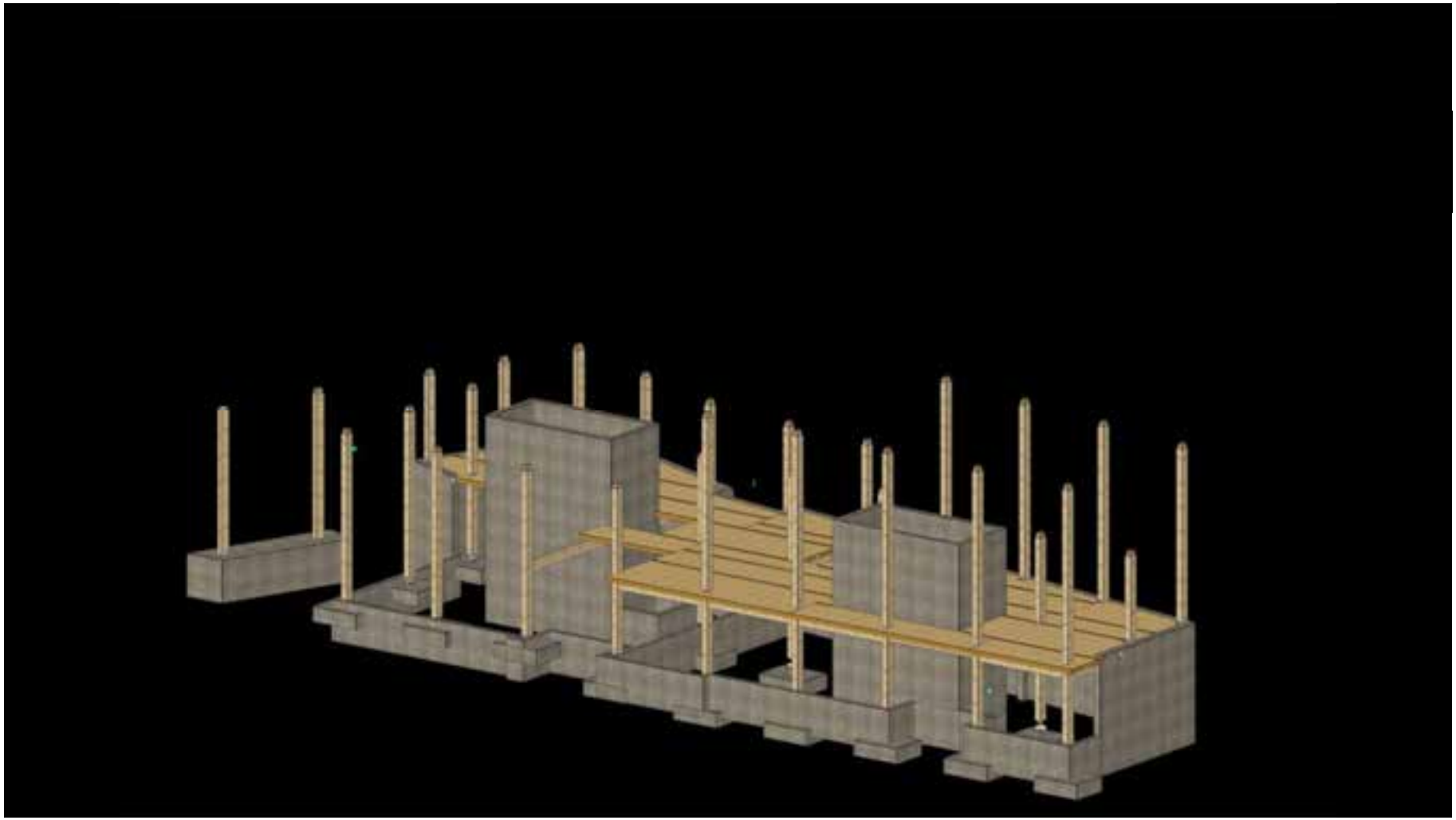


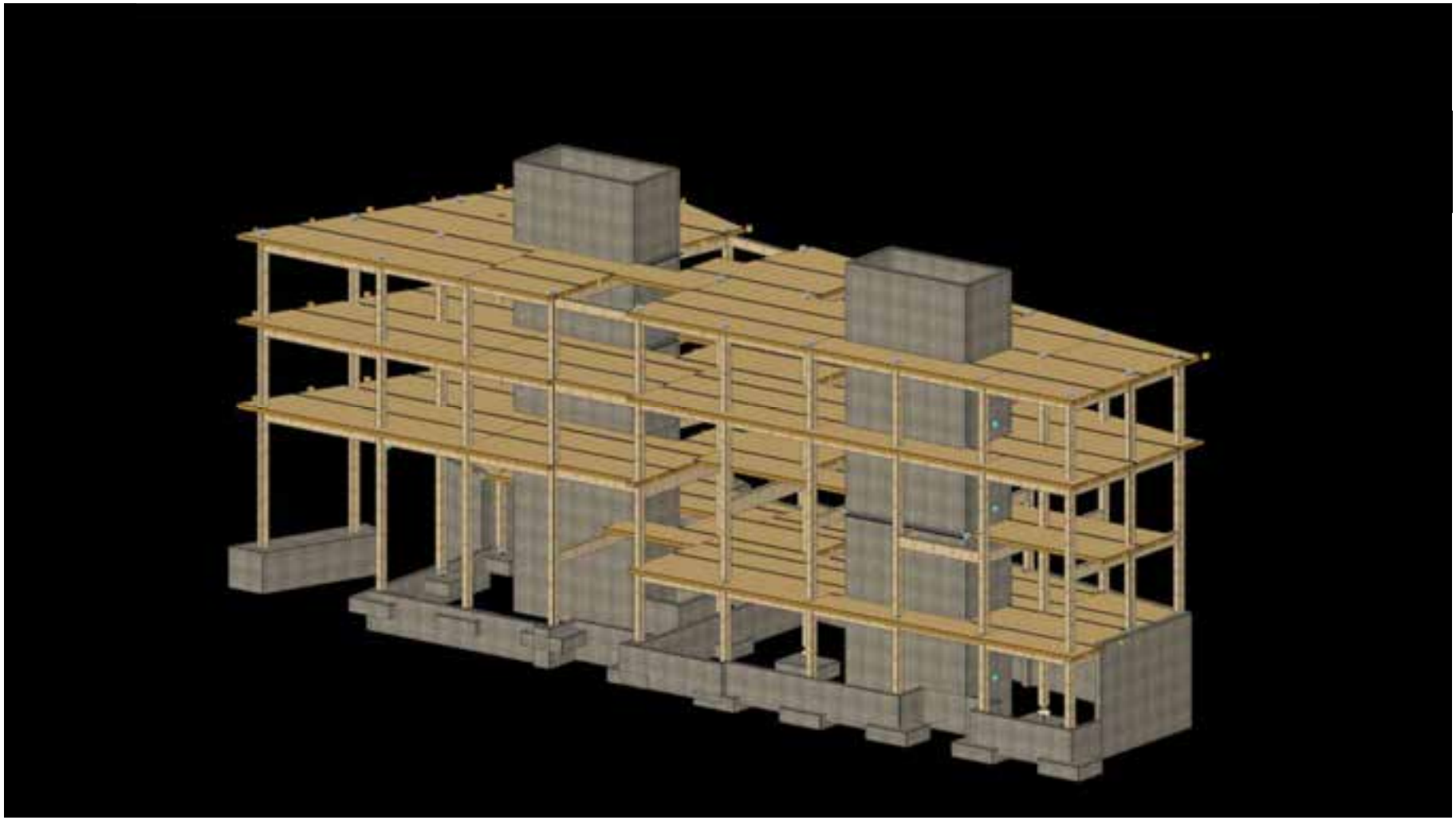












Delivering Success

- Logistics and Trucking Plans
- Regular communication of Schedule
- Trained Installation Crew

Sonoma Academy

Janet Durgin Guild & Commons

Owner: Sonoma Academy

Architect: WRNS Studio

Structural Engineer: Mar Structural

General Contractor: XL Construction

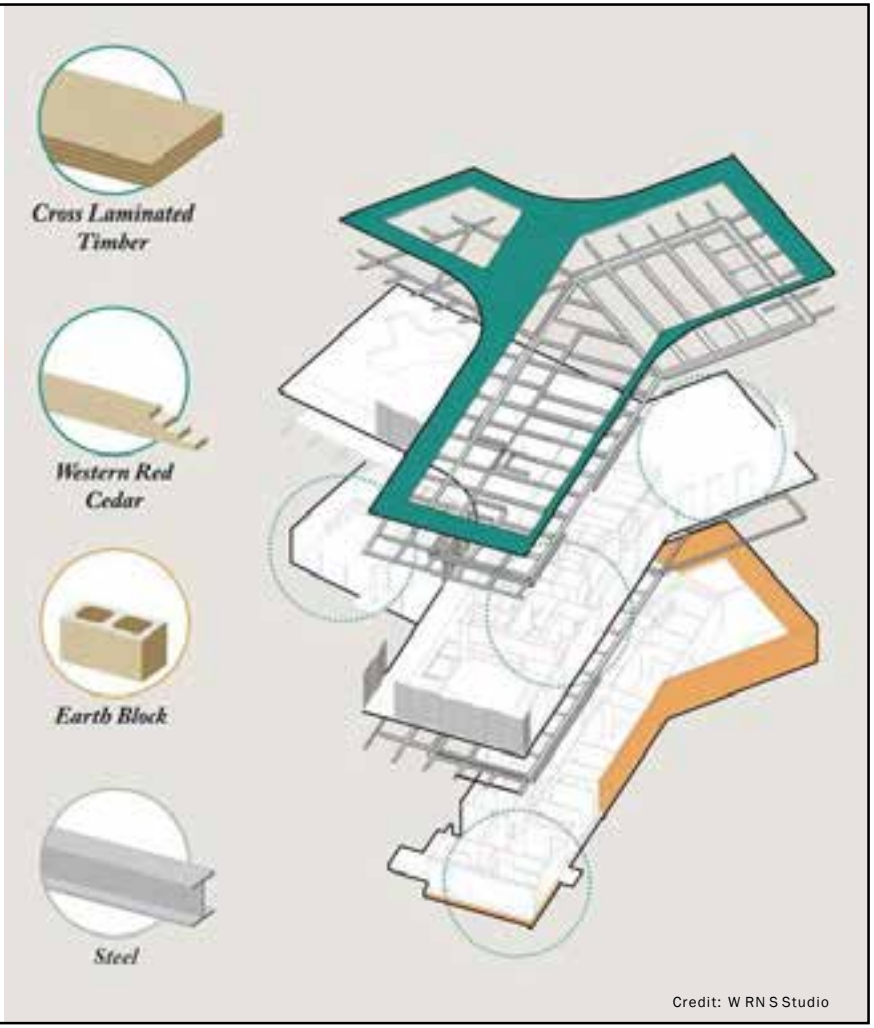
Timber Supplier: DR Johnson

Location: Santa Rosa, California

Sonoma Academy

Sonoma Academy

- Hybrid CLT & steel roof
- CLT exposed at exterior
- Curving edges of CLT
- Reclaimed wood beams



Sonoma Academy – Roof

- CLT & steel hybrid
- Exposed CLT soffit

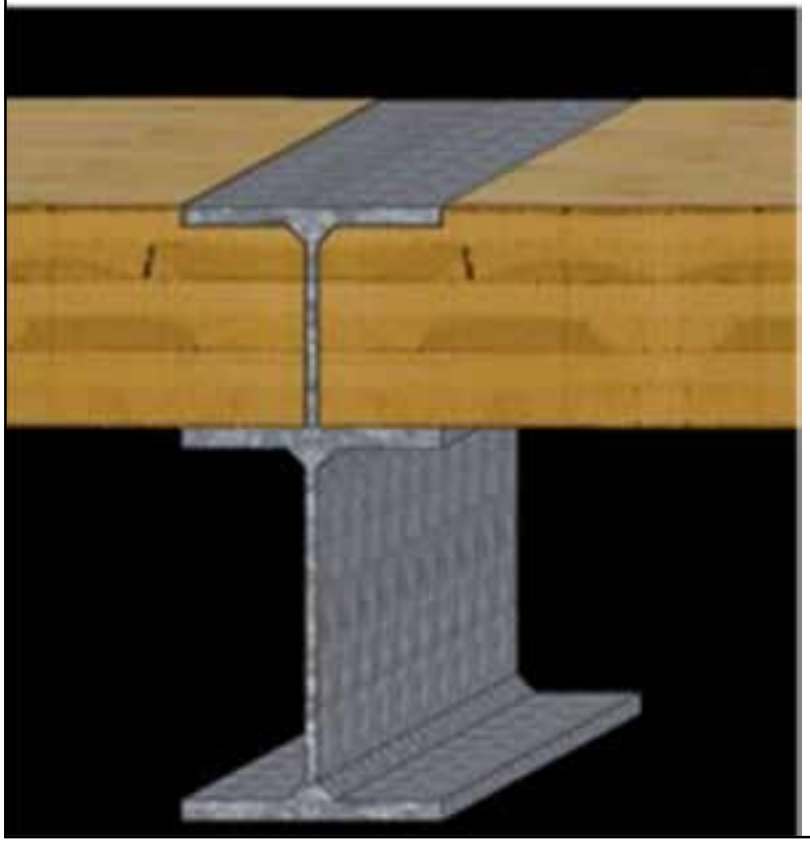
Sonoma Academy – CLT install

- Laydown area
- Small crew

Sonoma Academy – CLT curve

- Coordination between design team, steel and timber fabricators
- Tolerances

Sonoma Academy – CLT to steel detail



Sonoma Academy

Sonoma Academy

Photo: Jeremy Bittermann

Photo: Celso Rojas

Albina Yard

Owner/ GC: Reworks

Architect: LEVER Architecture

Structural Engineer: KPFF

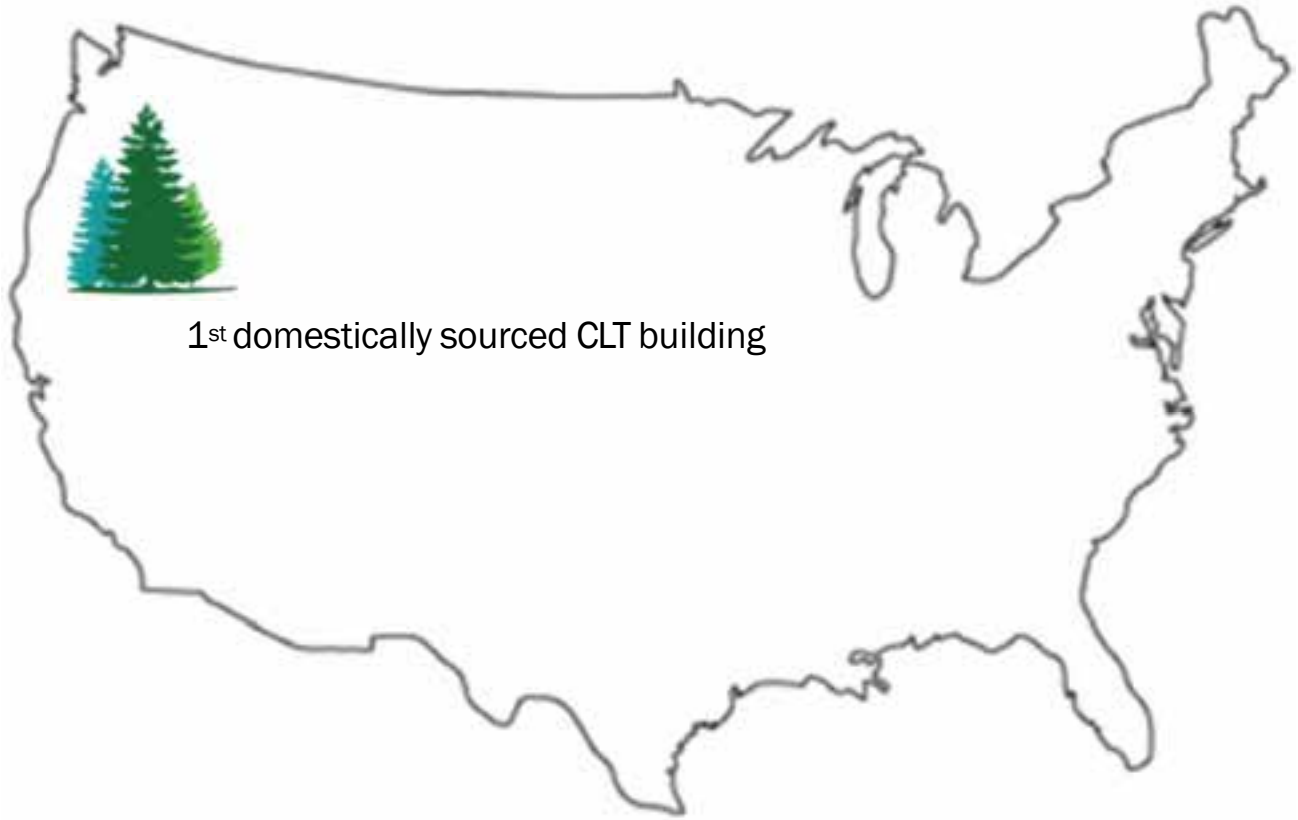
Timber Supplier: DR Johnson

Timber Fabrication: DR Johnson (CLT)
CutMyTimber (Glulam)

Project Support: WoodWorks


Photo: Lever Architecture

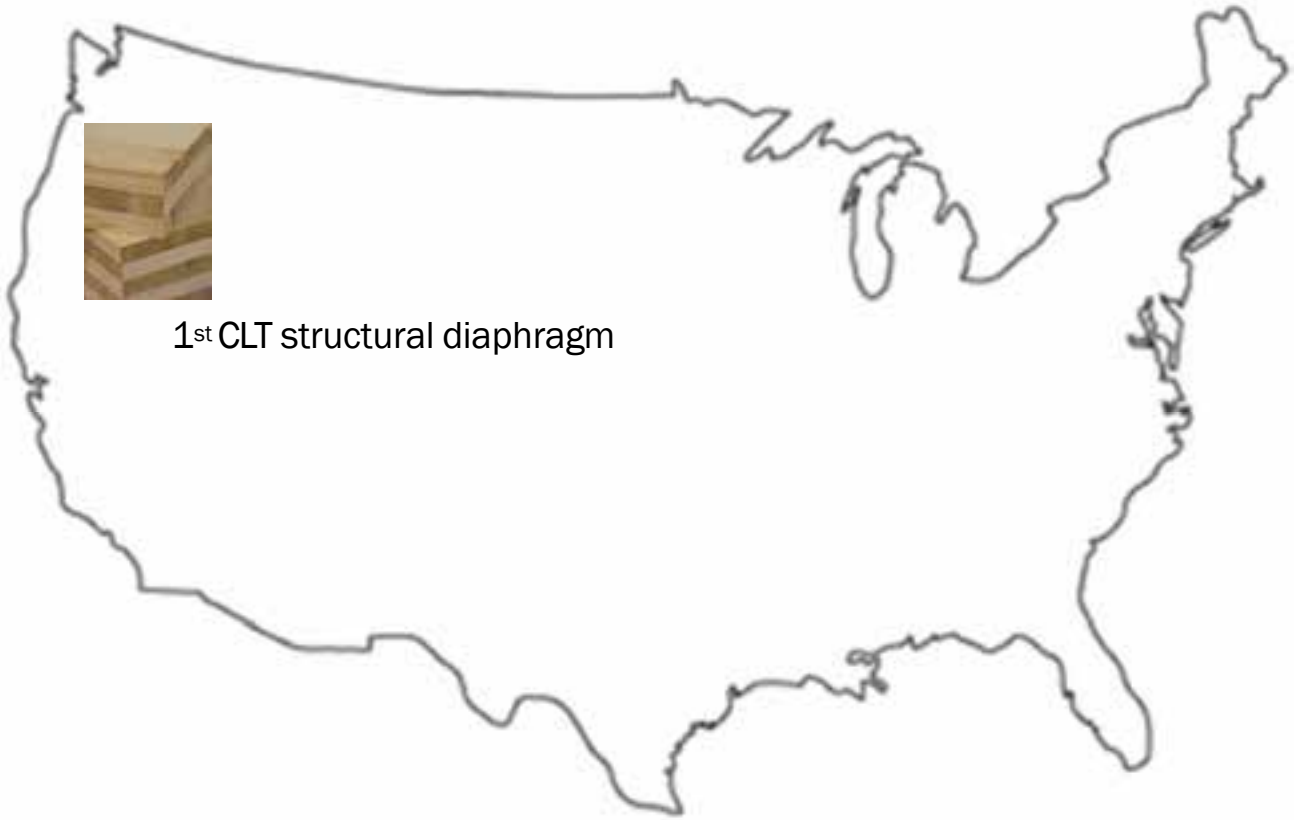
Albina Yard – First in the U.S.



1st domestically sourced CLT building

Albina Yard – First in the U.S.

1st CLT structural diaphragm



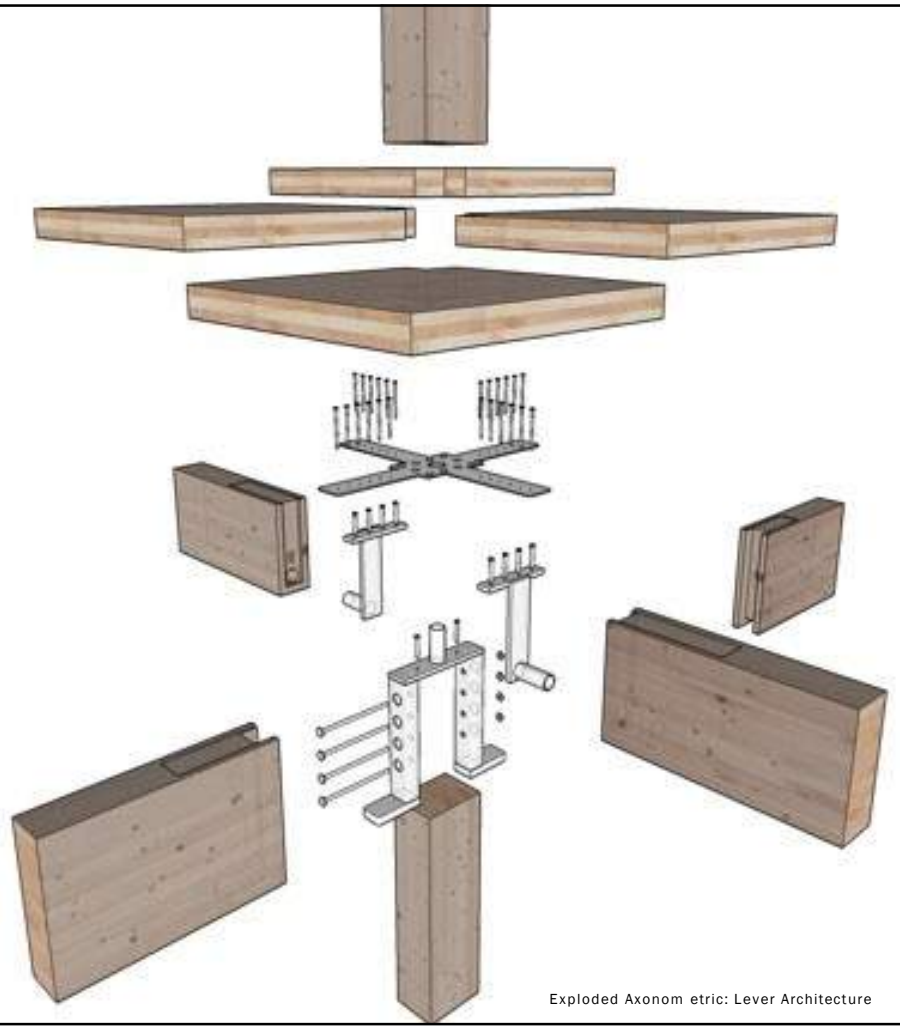
Albina Yard – Mass Timber

- CLT panels
  up to 10’ x 24’
- CLT cantilevers 4’
- Glue-laminated frame

Photo: Lever Architecture

Albina Yard

- Concealed connections
- Tight tolerances



Exploded Axonom etric: Lever Architecture

Albina Yard – Hundegger CNC

Albina Yard – Digital Fabrication

- CNC routed
- Tight tolerances

Photo: WoodWorks

Albina Yard – Concealed Steel Connectors

Photo: Lever Architecture


Photo: Lever Architecture

Albina Yard – CLT erection

Albina Yard – 16,000 sf Office


Photo: Lever Architecture


Photo: Lever Architecture

Albina Yard – CLT Central Stair

Albina Yard – Illuminating the path for more CLT in the U.S.

Early involvement of GC & fabricators

Efficient panel layout

Coordinating all MEP penetrations before fabrication

Accurate BIM model

Tolerances between trades

GC to pre-plan everything

Extremely fast construction

CLT Possibilities– 2-way spanning roofs & floors

Photo: Alex Schreyer

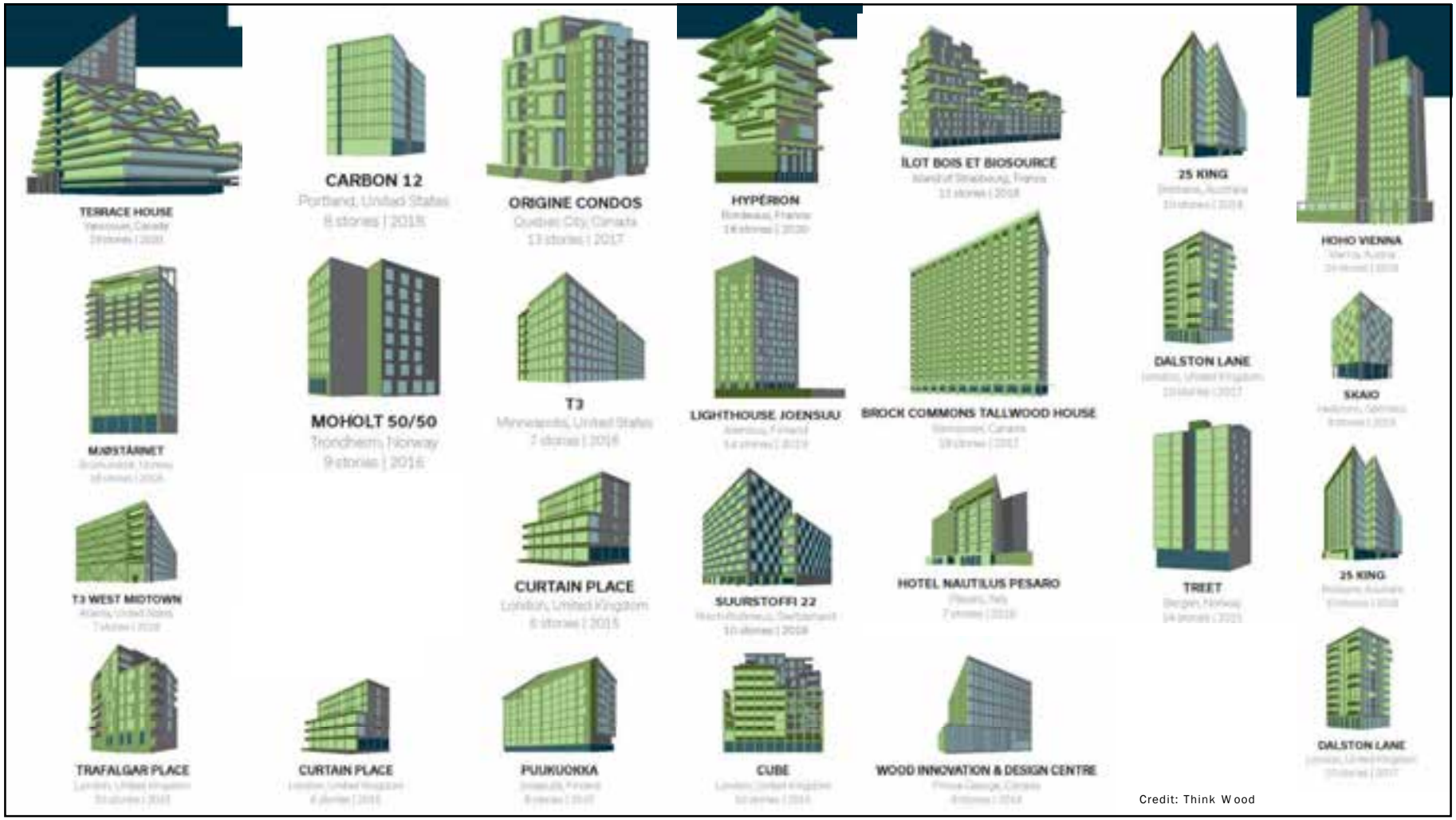
CLT Prefabrication – CNC

CLT Prefabrication – CNC

- MEP penetrations
- Joinery Fabrication
- Notches
- Shop installed connectors

Mass Timber – Future Applications

- Mid-rise commercial and multi-unit housing
- Modular construction
- Military buildings
- Buildings beyond 20 stories



Credit: Think Wood


MILLER PAINT

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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